

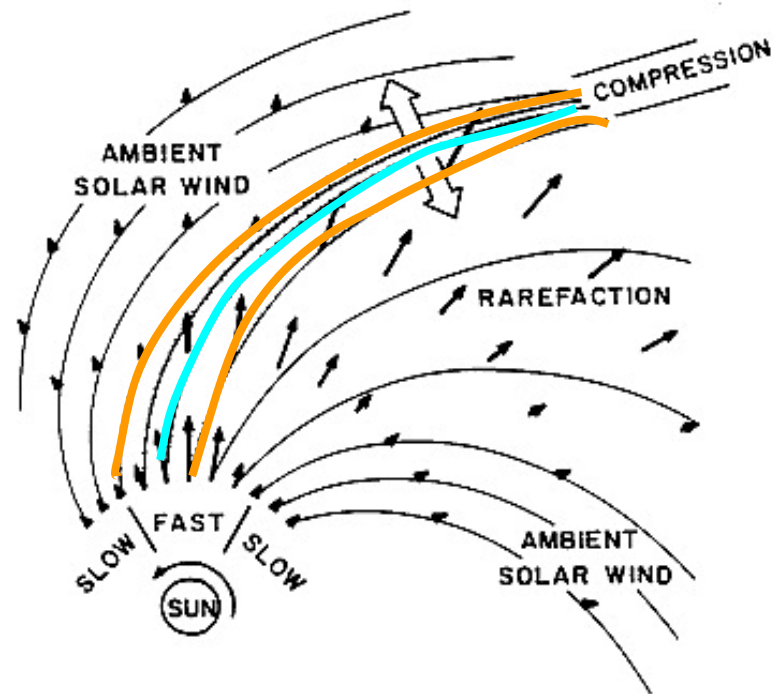
Solar Wind Stream Interface Evolution

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February 2009 STEREO SWG

What is a Stream Interface?

The light blue curve inside the CIR compression region marks the transition between slow and fast solar wind -- the stream interface (SI).



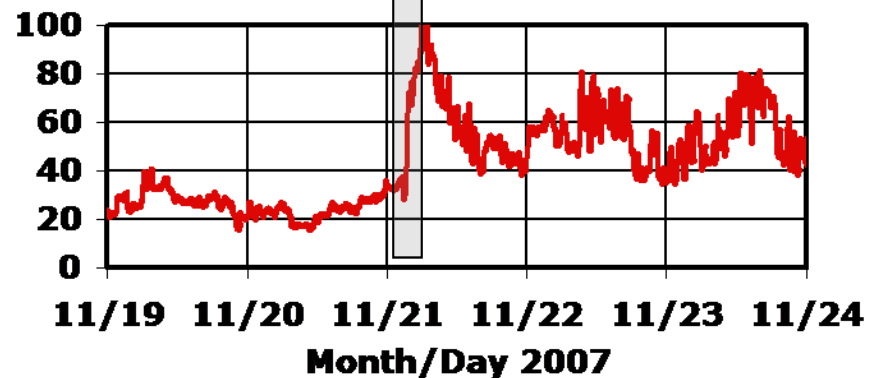
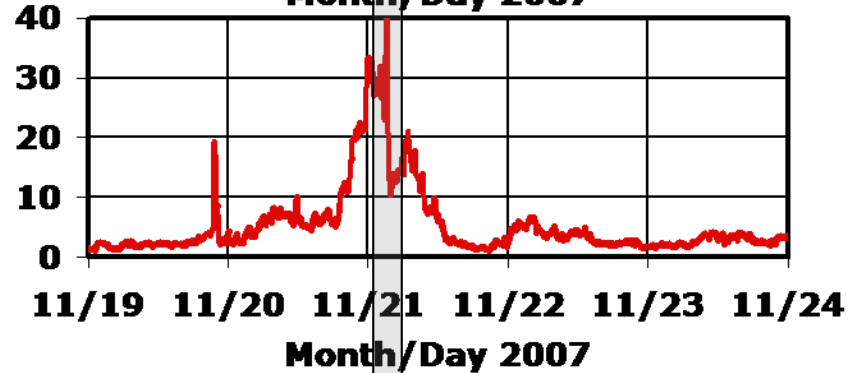
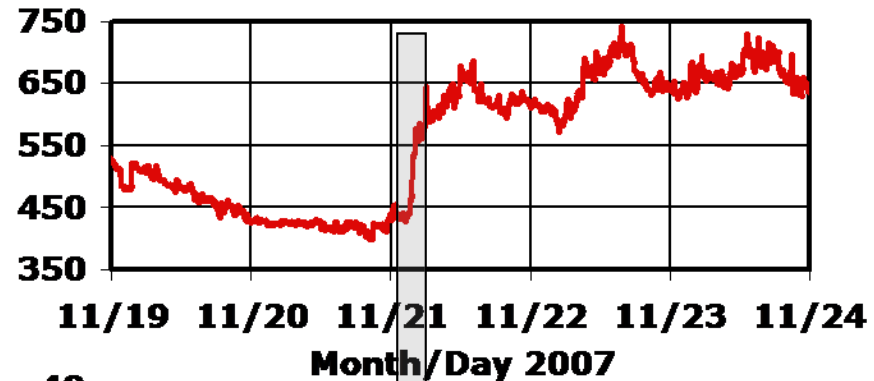
Pizzo, V. (1978), A three-dimensional model of corotating streams in the solar wind: 1. Theoretical foundations, *J. Geophys. Res.*, 83, 5563–5572.

in situ Stream Interface Example

1. Bulk Speed Increase

2. Density Drop

3. Temperature Increase



PLASTIC/AHEAD
10 minute averaged
bulk proton data

Goals of Study

CIR compression regions are known to be associated with geomagnetic activity at Earth. If we want to predict the arrival time of a CIR at Earth after it has been observed *in situ* by STEREO/BEHIND (or a future monitor at L5), we need some idea of how much deviation from the ideal Parker spiral geometry can occur.

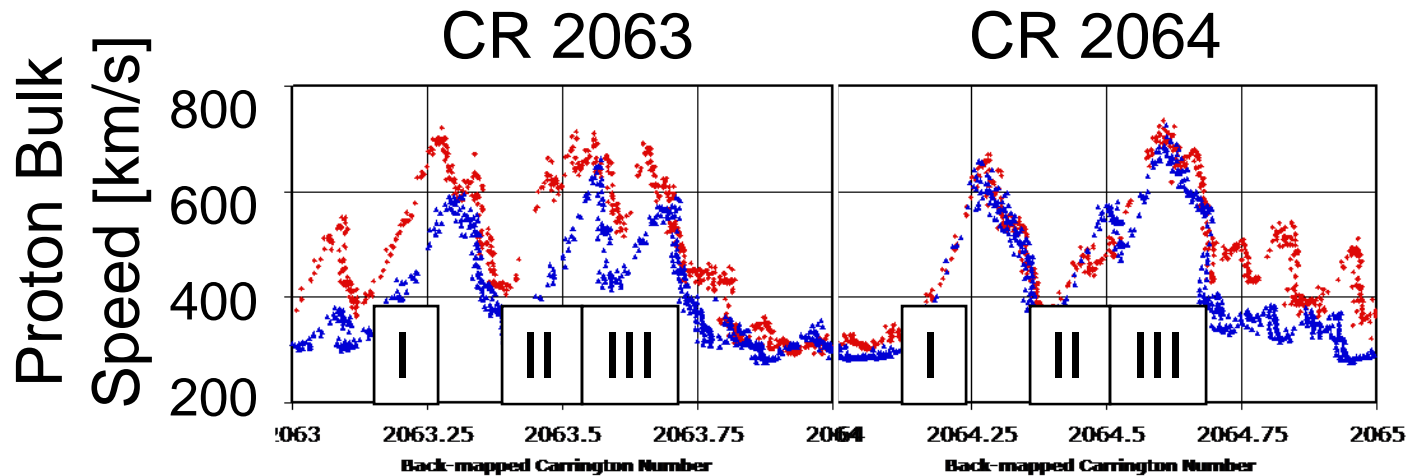
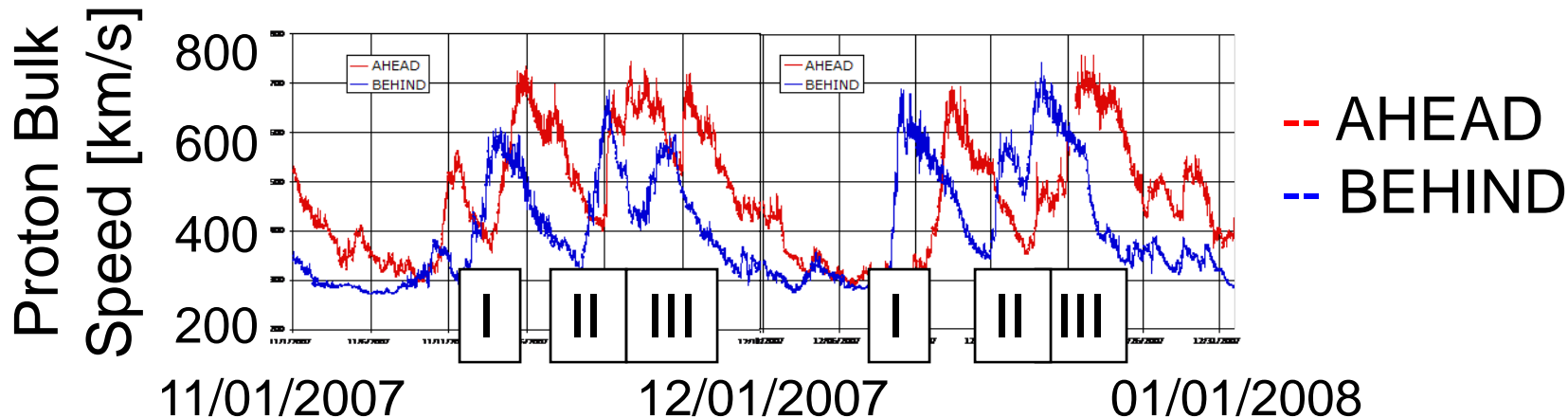
HCI latitude separation between Earth and STEREO/B can complicate matters further, but how much?

Why Stream Interfaces?

- I wanted a solar wind feature that was well defined to compare both between the two observatories, and from one Carrington rotation to the next.
- Their **idealized** geometry is simple.
- We have plenty of stream interface data to study since the Sun has been quiet.

Time goes from left to right.

Recurring Interfaces



Back-mapped Carrington Number

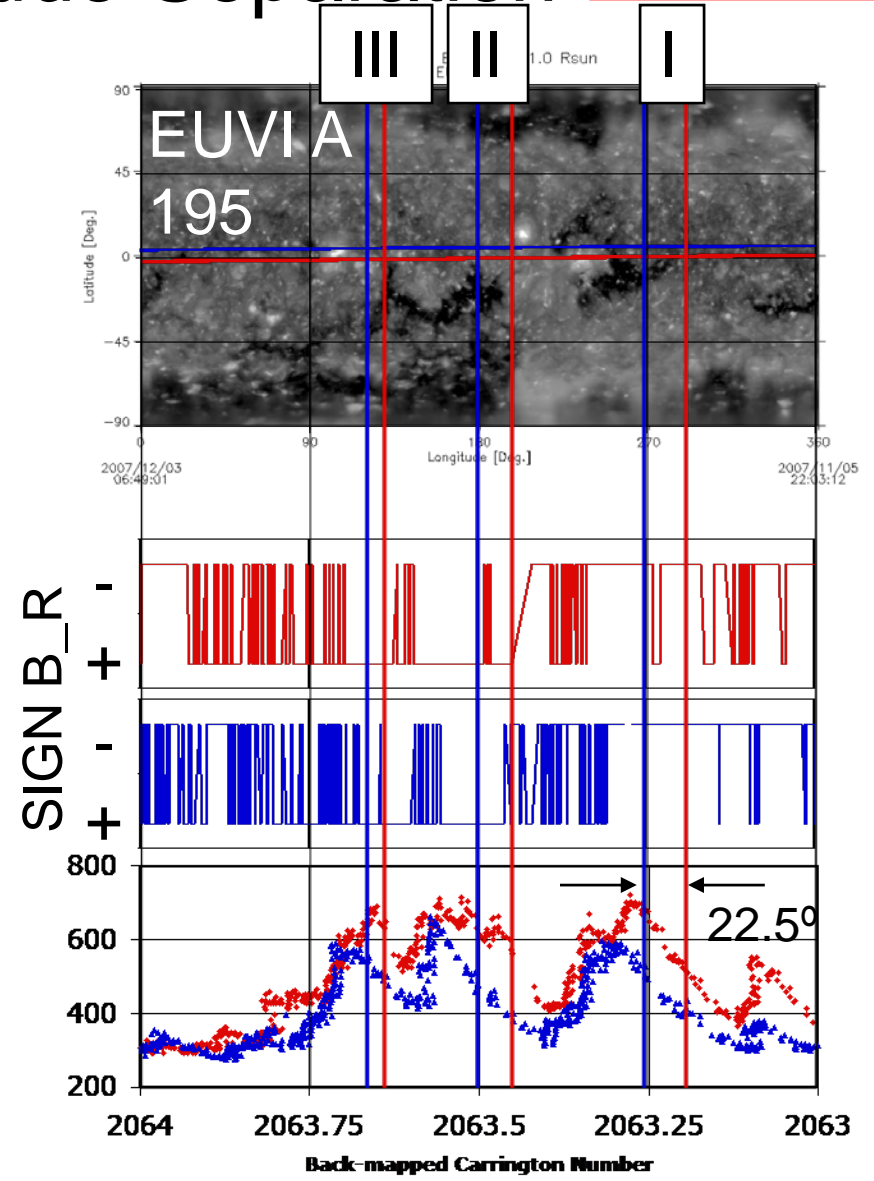
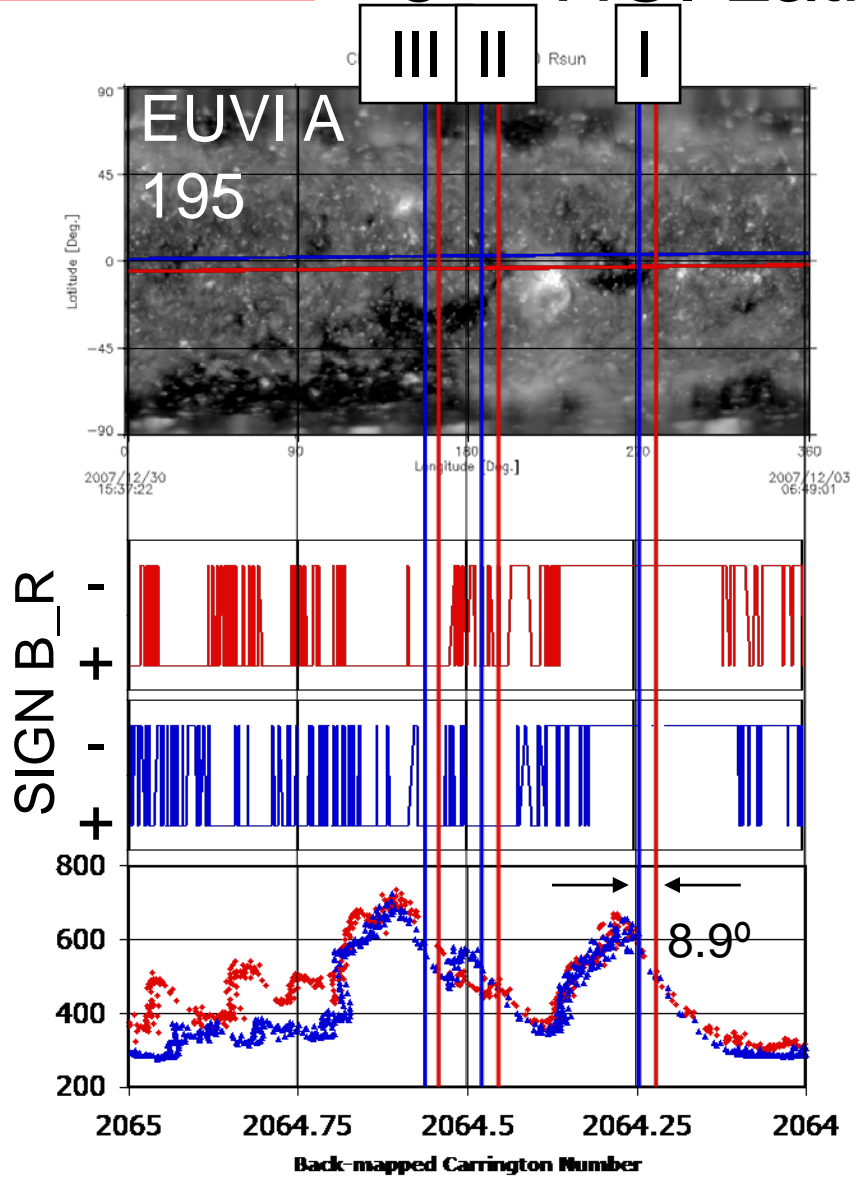
Note: Only the proton bulk speed is shown here, but the density and temperature criteria for an interface are also satisfied.

Time goes from right to left.

November - December 2007

$>5^\circ$ HCI Latitude Separation

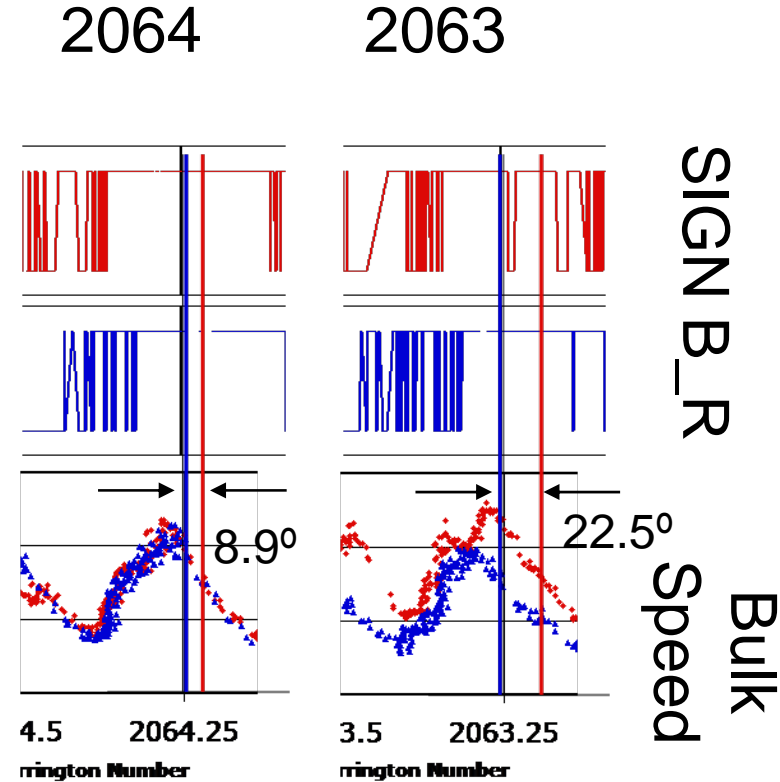
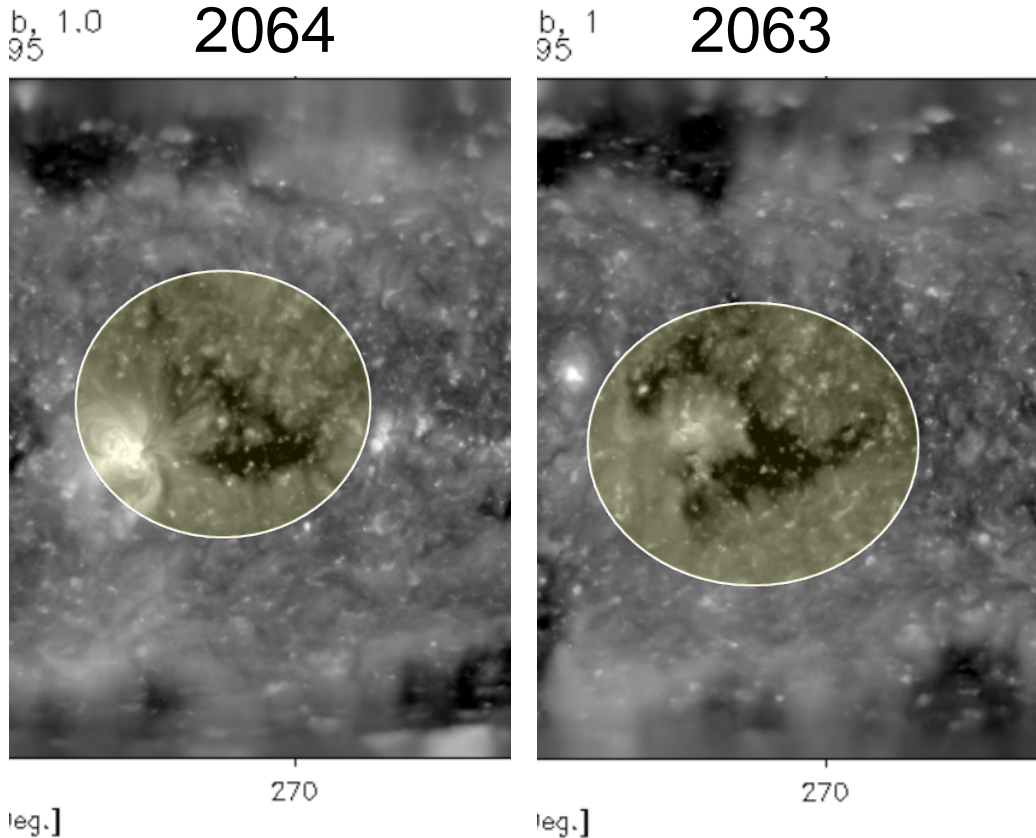
Time goes from right to left.



Time goes from right to left.

November - December 2007 5 - 6° HCI Latitude Separation

Time goes from right to left.



EUVI AHEAD
195 Å

Are there obvious changes on a shorter time scale?

Time goes
from left to
right.

SI I 2063

SECCHI EUVI 195 Å

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

SECCHI EUVI BEHIND
11/09/2007 16:26:10 UT.

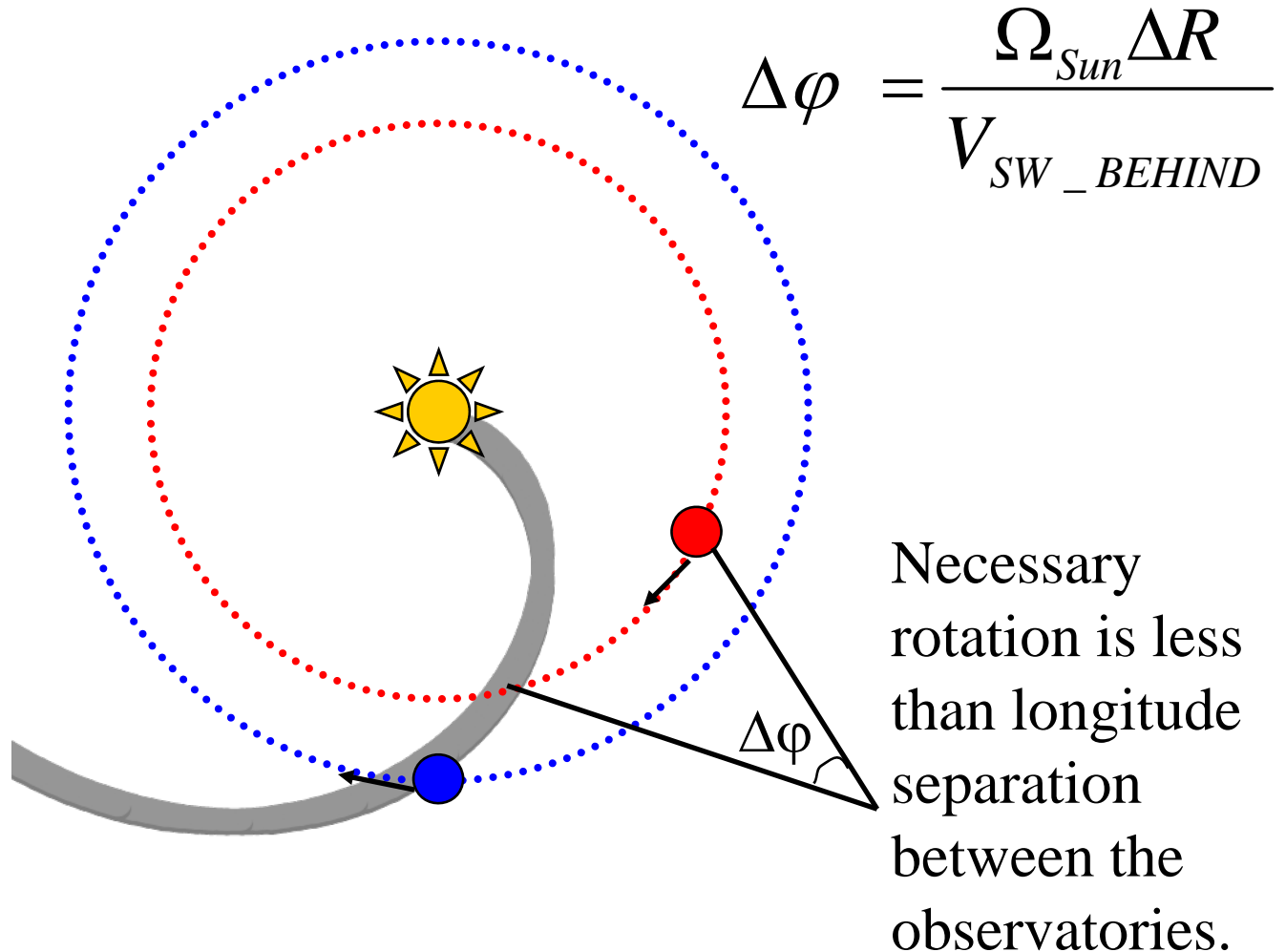
SECCHI EUVI AHEAD
11/12/2007 23:55:30 UT.

The Simplest Prediction Technique

Carrington Frame:

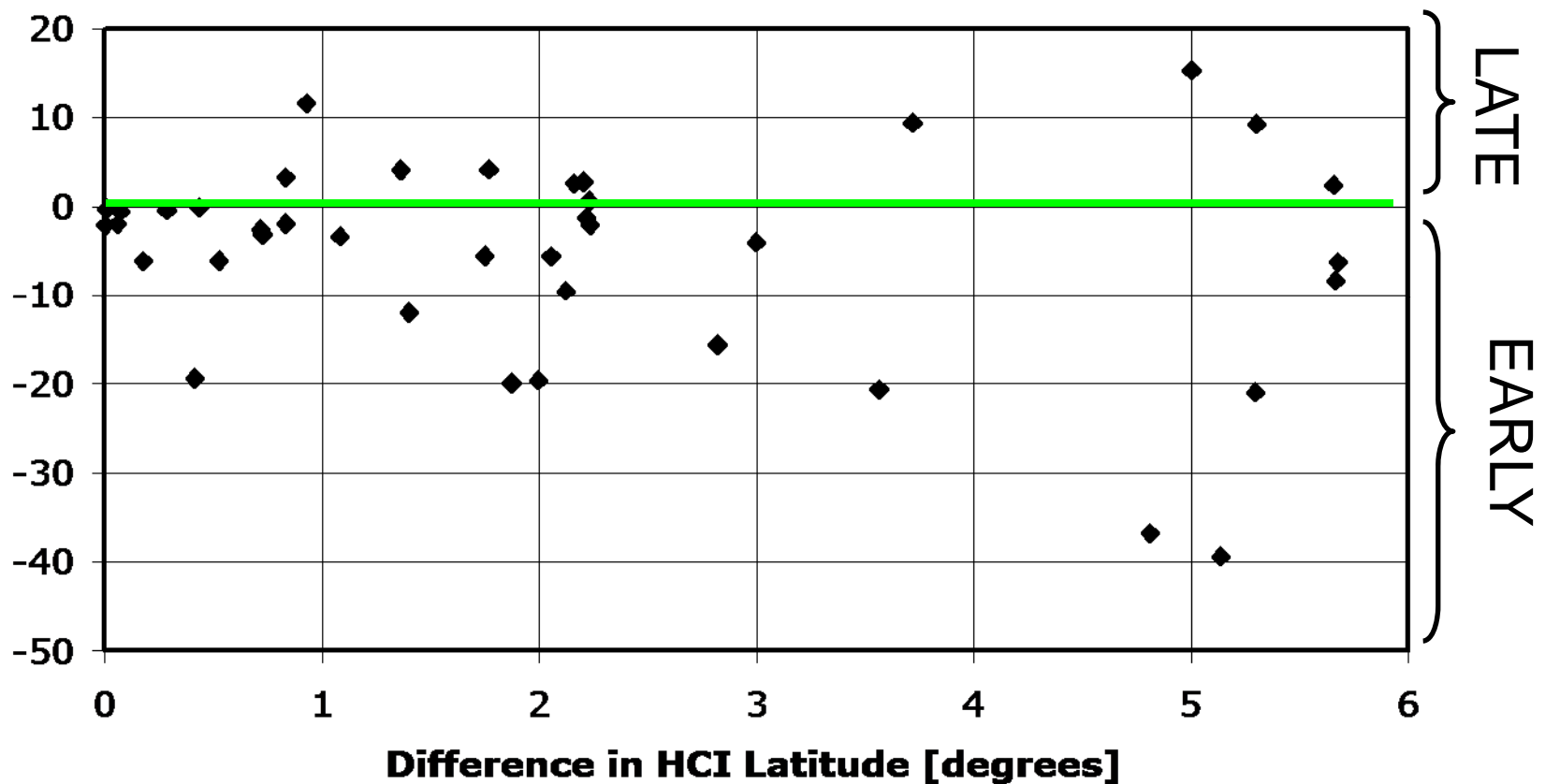
The SI is a static, ideal Parker spiral.

Observatories move clockwise.



Latitude Separation

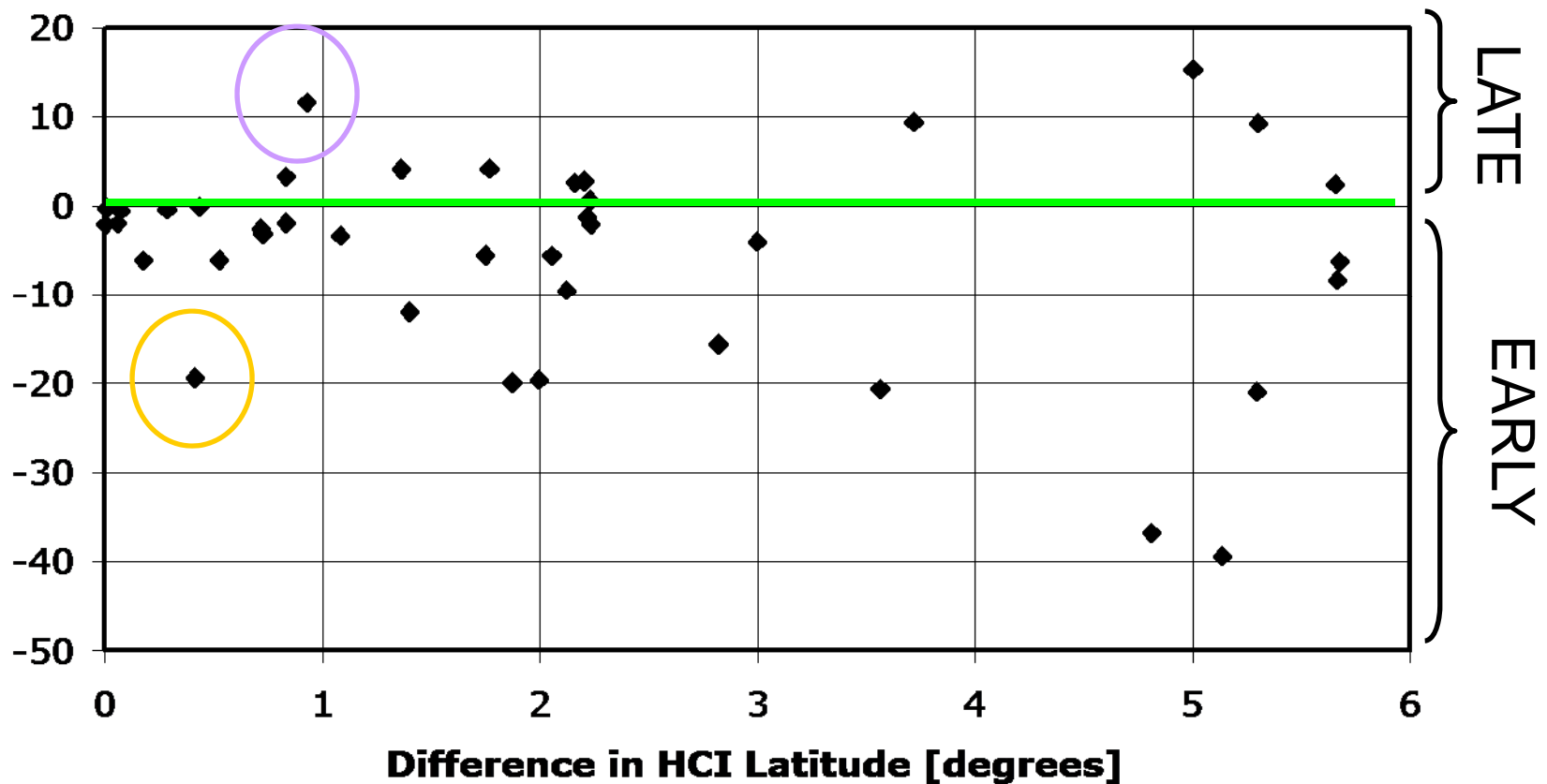
Difference between Expected and Actual Arrival Time at STEREO/A



70% ARRIVE EARLY

Latitude Separation

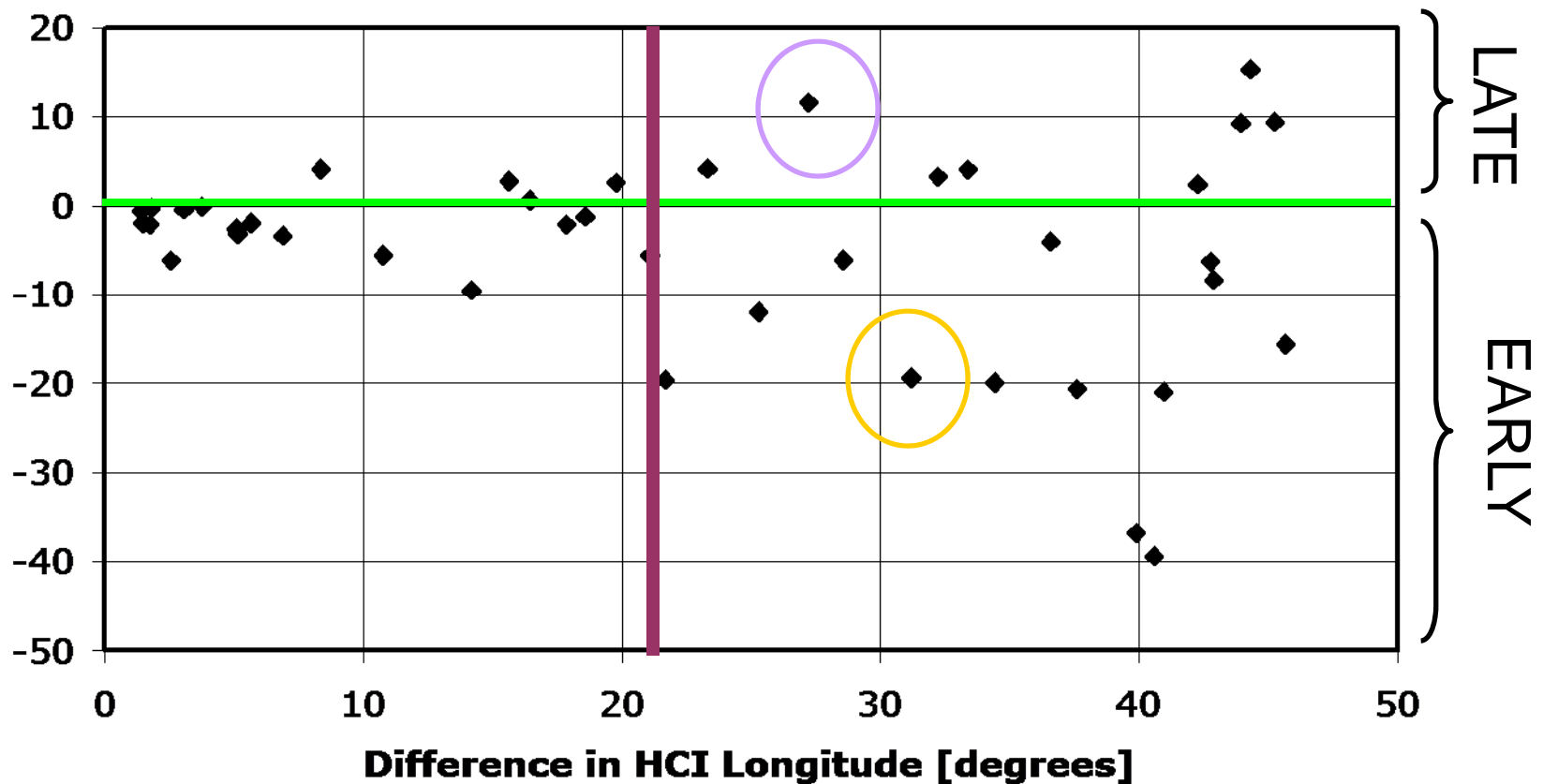
Difference between Expected and Actual Arrival Time at STEREO/A



70% ARRIVE EARLY

Longitude Separation

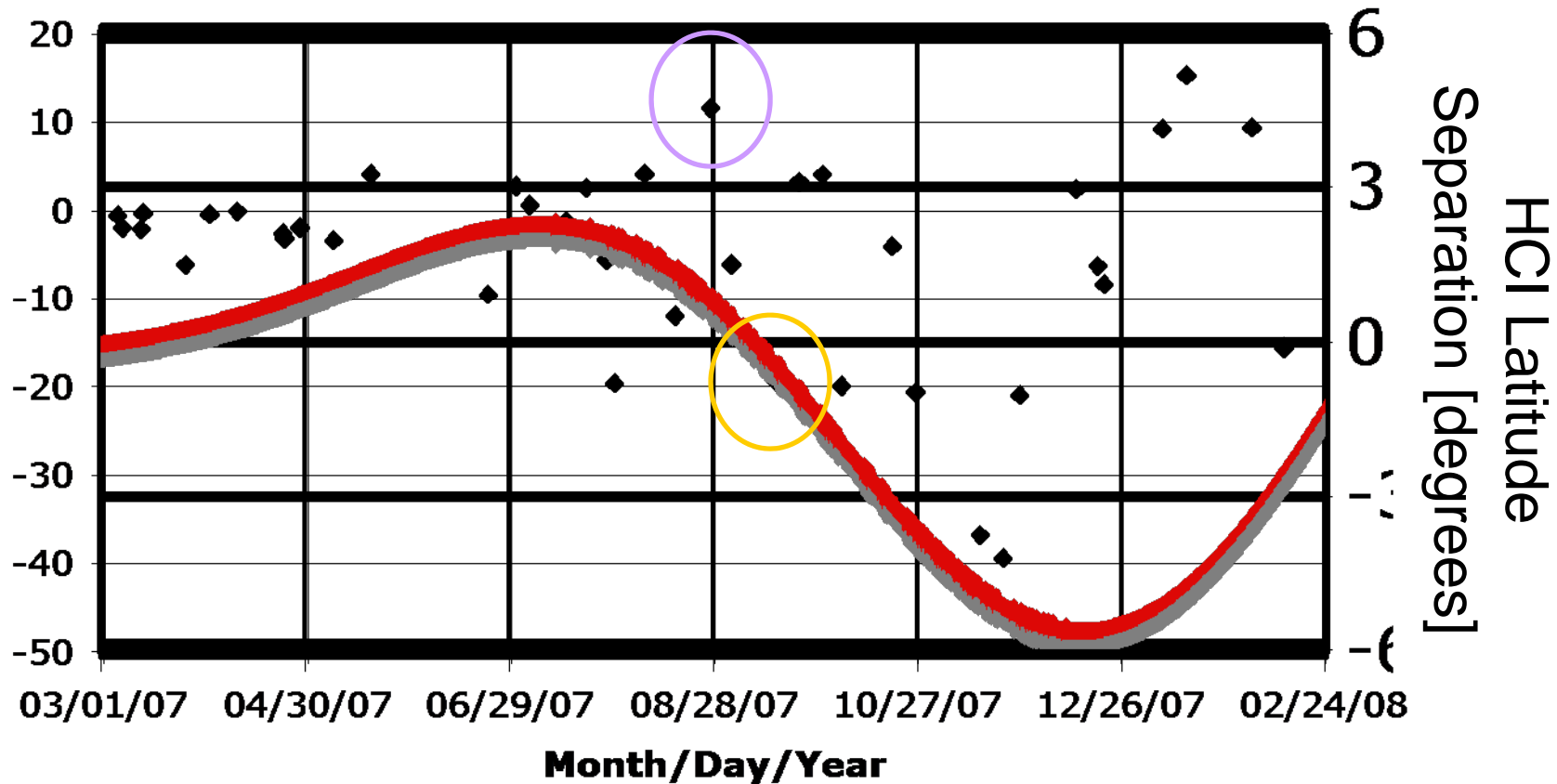
Difference between Expected and Actual Arrival Time at STEREO/A



70% ARRIVE EARLY

Trend Over Time

Difference between Expected and Actual Arrival Time at STEREO/A



70% ARRIVE EARLY

Summary

- Time (Longitude) separation and latitude separation are both important.
- Up to longitude separations of about 20° all SIs arrived within 10 hours of their expected arrival time
- The largest differences between expected and actual arrival times correspond with the largest latitude separations
- 70% of the stream interfaces arrived early at STEREO/AHEAD.

Thank You.